In this activity, students will play a game to simulate the outbreak of disease through a human population. They will then make conclusions about ways to prevent the spread of disease.

**OVERVIEW**

**Topic:** Diseases and populations

**Real-World Science Topics**
- An exploration of the spread of diseases through a population
- An exploration of ways to help prevent the spread of disease

**Objective**
Students will gain an understanding of the ways diseases can spread through a human population, and they will learn ways to help slow or prevent the spread of diseases and illnesses.

**Materials Needed for Teacher Demonstration**
- images from 1918 influenza pandemic (optional)

**Materials Needed for Students**
- several small strips of thick paper (such as card stock or construction paper)
- small plastic bags (one for each student)

**Teacher Preparation**
Prior to leading the activity, cut many small strips of paper so that each person in the class has six strips. Determine how many students in your class will be the initial “diseased population” for the disease simulation. (A good starting number might be five students, or approximately 25% of the classroom.) Mark dots on each of the six strips of paper for each of the five infected students. Fold the strips in half and place them in small plastic bags so that there are five bags containing six dotted strips. Fill each of the remaining small plastic bags with six blank strips of paper, folded in half.

**Standards Met**

**NATIONAL SCIENCE STANDARDS ADDRESSED**

**CONTENT STANDARD A:**
As a result of activities in grades 5-8, all students should develop
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry
CONTENT STANDARD C:
As a result of activities in grades 5-8, all students should develop an understanding of
• Structure and function in living systems
• Populations and ecosystems

CONTENT STANDARD E:
As a result of activities in grades 5-8, all students should develop
• Abilities of technological design
• Understandings about science and technology

CONTENT STANDARD F:
As a result of activities in grades 5-8, all students should develop an understanding of
• Science and technology in society

NATIONAL MATH STANDARDS ADDRESSED
• Investigate how a change in one variable relates to a change in a second variable.
• Identify and describe situations with constant or varying rates of change and compare them.
• Recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.
• Predict the probability of outcomes of simple experiments and test the predictions.
• Apply and adapt a variety of appropriate strategies to solve problems.

NATIONAL TECHNOLOGY STANDARDS ADDRESSED

CREATIVITY AND INNOVATION
Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:
• Apply existing knowledge to generate new ideas, products, or processes.
• Use models and simulations to explore complex systems and issues.
• Identify trends and forecast possibilities.

Sources:
1. **Warm-up Activity:** Begin by describing the events of the 1918 flu pandemic to your students. Tell them that at the end of World War I, a flu virus spread around the world. It is estimated that nearly 30 percent of all Americans became infected with the flu, and almost 700,000 Americans died. The severity of the 1918 flu outbreak caused American life expectancies to drop 10 years. Scientists knew little about viruses, so they were virtually helpless to stop the spread of the flu. If you have images available from the 1918 influenza outbreak, show them to your students.

Use this historical story to introduce the lesson, and then ask several questions to help assess students’ pre-existing knowledge about disease, infection, and epidemics. For example, have students brainstorm examples of diseases. Then, have them think about whether each disease they listed is contagious or not. Also, review with students the meanings of the words “epidemic” and “pandemic.” (See the **Teacher Background** section for more information on this.)

Make sure students understand that a disease is any disorder or ailment that occurs in our bodies. Not all diseases are contagious, but in this activity, they will specifically explore contagious diseases. Allow students to work with a partner to answer Questions 1 through 3 on the **Student Handout**.

2. Tell students that they will model the spread of an infectious disease by playing a game. The game will simulate an epidemic, which is a widespread occurrence of a disease. Remind students that in the real world, the spread of disease is not a game. This game is meant to model how disease can spread, but no one in the classroom will actually become sick as a result of this simulation. Before students begin a full exercise of the game, they should run a trial game first to be sure that they understand the rules. Explain to students that they will not know who is infected before the start of the game. Distribute pre-made bags of slips to students and then explain the following rules of the game:

- **Student desks** will represent their “homes.” Students will walk from their desks to the opposite end of the classroom, and then they will return to their desks. This motion represents a single day in a person’s life.

- **During a single day**, students should actively approach at least two other students and say “hello.” During this interaction, the students will exchange a slip of paper from their bags. Note: students should not look at the slips during this exchange.

- **While the student should actively attempt to interact with only two people during the day**, it is possible that additional interactions will occur, since other students will be attempting to interact as well. Tell students that this is okay. If they are approached by another student, they should respond by saying “hello” and exchanging a slip of paper. Remind students that they should only *initiate* an interaction twice.

- **Once a student has returned to his or her desk, he or she should remain there until all students have returned to their desks.**

Have students perform a test run of this game for a single day. At the end, have students open up their packets and observe the slips of paper. They should count how many slips have a “dot” marked on them. If students have at least three dots, they have acquired a disease.
3. Once students are comfortable with the rules of the game, students should run the basic version of the game (described below) and then investigate modifications of the game to observe how different variables affect the spread of disease through a population:

- **Basic game:** Students will run the game for numerous days. At the end of each day, students should open their packets and secretly determine whether or not they have been infected with the disease (i.e., they should count their slips and see if they have at least three dotted slips). Have the entire class close their eyes and instruct students who have been infected with the disease to raise their hands. Quickly count the number of infected students and make a note of how many are infected each day. Have students continue this process until all of the students in the class have been infected. Then, reveal to students how many of them were infected each day. Have students record this information in a data chart.

- **Initial disease population:** Distribute new packets of slips. This time, increase or decrease the number of students who are initially infected with the disease.

- **Close living quarters:** Change the rules of the game so that students must interact with at least four people each day. This represents an environment where people live in close quarters and interact on a more regular basis.

- **Vaccinations:** Pass out sheets of paper to each student facedown. The sheet should say “vaccinated” or “unvaccinated.” Have students turn their sheets over and note whether or not they are vaccinated. Explain that students who are vaccinated will have better immune systems, and they will need to have five dotted slips in order to get the disease. (Alternatively, you may designate all vaccinated students as “completely immune,” which means they will never get the disease, no matter how many dotted slips they acquire.)

- **Quarantine:** At the end of each day, have students raise their hands if they have been infected. This time, students can do this publicly. All students who are infected will be told to sit out (in other words, “stay at home”) for the next rounds.

4. **Wrap-up Activity:** Have students analyze the results of the different games. Students should create simple line graphs for each variation of the game representing the number of infected students over time. Have students think about how each of the modifications to the activity changed the rate at which disease spread through the classroom. In which situations did the disease spread fastest? How did vaccinations and quarantine help reduce the spread of the disease? Have students connect this activity to the spread of disease in the real world. Based on this activity, ask students where they think disease is most likely to spread in the world and why. Have them brainstorm ways they could reduce the spread of disease in those areas.

End the activity by discussing the ways to prevent the spread of disease, and make sure students understand that they can help keep themselves and their classmates healthy by following a few simple steps, such as washing their hands and covering their mouths when they cough. More information on preventing the spread of disease is located in the Teacher Background section.
**Epidemic! Extension Activities**

1. Have student groups develop short skits that show how diseases are spread and how they can be prevented. Groups should write short scripts, and each student in the group should act at least one part. Allow students time to rehearse, and then have each group present their skit to the class. Take a moment after each skit to discuss the main ideas found in each skit.

2. Have students research a different topic on diseases. Sample ideas include researching a specific disease, the history of disease prevention, new disease treatments, and so on. Students can conduct research in the class or as homework, and present their findings in poster form. If the technology is available, have students present their findings in an electronic slideshow presentation on a computer.
**What is a disease?**

A disease is any condition or disorder within a living organism that produces a set of specific symptoms. For example, the flu produces symptoms such as fever, aches and pains, and vomiting. Diseases can be contagious (also called infectious) or not, and they can have a wide range of symptoms. Diseases are not a result of physical harm or injury; they can be caused by numerous factors, including the spread of germs, uncontrolled cell growth, or genetics. Some common contagious diseases include the cold and flu, chicken pox, and measles. Non-contagious diseases include cancer, Alzheimer’s disease, and diabetes.

**What is the difference between a disease and an epidemic?**

An epidemic is a disease that has spread among a large population. For example, a state or county might have widespread occurrences of the influenza virus, causing the local health department to call it an epidemic. If an epidemic goes unchecked and spreads across a larger region, such as a country or the world, the epidemic becomes a pandemic.

**How are diseases commonly spread?**

In human populations, diseases are often spread through close contact. Because infectious diseases can be caused by many different types of microorganisms, there are many different ways we can become infected with diseases. Some of the different paths for contagion include person-to-person contact (involving the transfer of germs or bodily fluids), animal to person (including insect bites), and indirect contact (such as touching a doorknob that contains germs).

**What are ways we can prevent the spread of disease?**

There are several methods available to help prevent the spread of disease. One of the most effective ways is also the easiest: regular and thorough hand washing with warm water and soap. It is especially important for sick people to regularly wash their hands; this can help prevent both person-to-person infection and indirect infection.

Some diseases, such as the measles, have vaccines available. It is standard for children to be immunized against common diseases and illnesses at a young age. Because of immunizations, many serious illnesses have been eradicated from the United States. Smallpox is one such example. Since 1972, Americans do not receive the smallpox vaccine because it is no longer a threat.

Other methods for preventing the spread of disease include limiting contact with sick people. People who are sick should take precautions to limit their time around groups of people. They can stay home from school or work and avoid sharing objects like toothbrushes. Properly cooking all food can reduce the spread of disease. Uncooked eggs, for example, can spread the disease salmonella.

**Key vocabulary:**

- **disease:** a disorder in a human or animal that produces specific symptoms, not related to an injury
- **epidemic:** a disease that occurs over a broad population, affecting many people or animals
- **germ:** a microorganism that causes disease
- **infected:** to have a disease
- **pandemic:** a widespread epidemic, affecting an entire country or the world
1. Work with a partner to develop a definition for the word “disease.” Write it below.
   [Sample answer: A disease is anything that makes us feel sick or causes us to be unhealthy.]

2. Some diseases are infectious, meaning that they can spread from person to person (or animal to person). Work with your partner to list at least three different infectious diseases.
   [Sample answer: Three infectious diseases are the flu, malaria, and pinkeye.]

3. Now, work with your partner to list at least three diseases that are not contagious.
   [Sample answer: Three non-infectious diseases are diabetes, cancer, and heart disease.]

4. Create a data chart to record the number of people who were infected with the disease each day during the simulation. You should create a new data chart for each simulation you investigate.
   [See sample data chart below.]

<table>
<thead>
<tr>
<th>Day</th>
<th>Number of Infected People</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>

5. Create a table, bar graph, or line graph to show how the number of infected people changed each day of the simulation. Create a graph for each simulation you investigated.
   [Sample graph below.]

![Graph showing the number of infected people over time.]

6. Brainstorm at least three different ways to help prevent the spread of disease.
   [Sample answer: To prevent the spread of disease, people should wash their hands all the time, especially if they are sick. They should stay home if they are sick. People should also only use their own personal items, like drinking glasses. When we share those things, we can pass germs to each other.]

7. What do you know about diseases that you didn’t know before this activity? What else would you like to learn about disease?
   [Sample answer: I now know that disease can be infectious or not infectious. I would like to know more about non-infectious diseases like cancer and how scientists are working to find cures.]
1. Work with a partner to develop a definition for the word “disease.” Write it below.

2. Some diseases are infectious, meaning that they can spread from person to person (or animal to person). Work with your partner to list at least three different infectious diseases.

3. Now, work with your partner to list at least three diseases that are not contagious.
4. Create a data chart to record the number of people who were infected with the disease each day during the simulation. You should create a new data chart for each simulation you investigate.

5. Create a table, bar graph, or line graph to show how the number of infected people changed each day of the simulation. Create a graph for each simulation you investigated.
6. Brainstorm at least three different ways to help prevent the spread of disease.

7. What do you know about diseases that you didn't know before this activity? What else would you like to learn about disease?